CLAIMS

1. A method for generating a signal having a frame structure, each frame of said frame structure comprising at least one useful symbol (12), a guard interval (14) associated to said at least one useful symbol (12) and a reference symbol (16), said method comprising the steps of:

performing an amplitude modulation of a bit sequence, the envelope of the amplitude modulated bit sequence defining the reference pattern of said reference symbol (16); and

inserting the amplitude modulated bit sequence into said signal as said reference symbol (16).

2. The method according to claim 1, wherein said signal is an orthogonal frequency division multiplexed signal.

3. The method according to claim 1 or 2, wherein said amplitude modulation is performed such that a mean amplitude of said reference symbol (16) substantially corresponds to a mean amplitude of the remaining signal.

4. A method for generating a multi-carrier modulated signal having a frame structure, each frame of said frame structure comprising at least one useful symbol (12), a guard interval (14) associated to said at least one useful symbol (12) and a reference symbol (16), said method comprising the steps of:

providing a bitstream (104);

mapping bits of said bitstream (104) to carriers in order to provide a sequence of spectra (108);

performing an inverse Fourier transform (110) in order to provide multi-carrier modulated symbols (112);

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associating (114) a guard interval to each multi-carrier modulated symbol;

generating said reference symbol (16) by performing an amplitude modulation of a bit sequence, the envelope of the amplitude modulated bit sequence defining the reference pattern of said reference symbol;

associating (116) said reference symbol (16) to a predetermined number of multi-carrier modulated symbols and associated guard intervals in order to define said frame; and

inserting said amplitude modulated bit sequence into said signal as said reference symbol (16).

5. The method according to claim 4, wherein said multi-carrier modulated signal is an orthogonal frequency division multiplex signal.

6. The method according to claim 4 or 5, wherein said amplitude modulation is performed such that a mean amplitude of said reference symbol (16) substantially corresponds to a mean amplitude of the remaining multi-carrier modulated signal.

7. The method according to one of claims 1 to 6, wherein said bit sequence is a pseudo random bit sequence having good autocorrelation characteristics.

8. The method according to one of claims 1 to 7, wherein a number of useful symbols (12) in each frame is defined depending on channel properties of a channel (122) through which the signal or the multi-carrier modulated signal is transmitted.

9. A method for frame synchronization of a signal having a frame structure, each frame of said frame structure comprising at least one useful symbol (12), a guard

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interval (14) associated with said at least one useful symbol (12) and a reference symbol (16), said method comprising the steps of:

receiving said signal;

down-converting said received signal;

performing (164) an amplitude-demodulation of said down-converted signal in order to generate an envelope;

correlating (166) said envelope with a predetermined reference pattern in order to detect the signal reference pattern of said reference symbol (16) in said signal; and

performing said frame synchronization based on the detection of said signal reference pattern.

10. The method according to claim 9, further comprising the step of performing a fast automatic gain control (162) of said received down-converted signal prior to the step of performing said amplitude-demodulation (164).

11. The method according to claim 9 or 10, wherein the step of performing (164) said amplitude-demodulation comprises the step of calculating an amplitude of said signal using the $alpha_{max+}$ $beta_{min-}$ method.

12. The method according to claim 9 or 10, further comprising the steps of sampling respective amplitudes of said received down-converted signal and comparing said sampled amplitudes with a predetermined threshold in order to generate a bit sequence in order to perform said amplitude demodulation.

13. The method according to claim 12, wherein the step of sampling respective amplitudes of said received down-converted signal further comprises the step of performing an over-sampling of said received down-converted

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signal.

14. The method according to any one of claims 9 to 13, further comprising the step of applying a result of the frame synchronization for a frame in said signal to at least one subsequent frame in said signal.

15. A method for frame synchronization of a multi-carrier modulated signal having frame structure, each frame of said frame structure comprising at least one useful symbol (12), a guard interval (14) associated to said at least one useful symbol (12) and a reference symbol (16), said method comprising the steps of:

receiving said multi-carrier modulated signal;

down-converting said received multi-carrier modulated signal;

performing (164) an amplitude-demodulation of said down-converted multi-carrier modulated signal in order to generate an envelope;

correlating (166) said envelope with a predetermined reference pattern in order to detect the signal reference pattern of said reference symbol in said multi-carrier modulated signal;

performing said frame synchronization based on the detection of said signal reference pattern;

extracting (136/138) said reference symbol (16) and said at least one guard interval (14) from said down-converted received multi-carrier modulated signal based on said frame synchronization;

performing (140) a Fourier transform in order to provide a sequence of spectra from said at least one useful symbol;

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de-mapping (142) said sequence of spectra in order to provide a bitstream.

16. The method according to claim 15, further comprising the step of performing (162) a fast automatic gain control of said received down-converted multi-carrier modulated signal prior to the step of performing said amplitude-demodulation.

17. The method according to claim 15 or 16, wherein the step of performing (164) said amplitude-demodulation comprises the step of calculating an amplitude of said multi-carrier modulated signal using the $alpha_{max+}$ $beta_{min-}$ method.

18. The method according to claim 15 or 16, further comprising the steps of sampling respective amplitudes of said received down-converted multi-carrier modulated signal and comparing said sampled amplitudes with a predetermined threshold in order to generate a bit sequence in order to perform said amplitude demodulation.

19. The method according to claim 18, wherein the step of sampling respective amplitudes of said received down-converted multi-carrier modulated signal further comprises the step of performing an over-sampling of said received down-converted multi-carrier modulated signal.

20. The method according to one of claims 15 to 19, further comprising the step of applying a result of the frame synchronization for a frame in said signal to at least one subsequent frame in said multi-carrier modulated signal.

21. The method according to one of claims 9 to 20, further comprising the step of detecting a location of said signal reference pattern based on an occurrence of a maximum of a correlation signal when correlating said envelope with said predetermined reference pattern.

22. The method according to claim 21, further comprising the

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steps of:

weighting a plurality of maxima of said correlation signal such that a maximum occurring first is weighted stronger than any subsequently occurring maximum; and

detecting said location of said signal reference pattern based on the greatest one of said weighted maxima.

23. The method according to claim 22, further comprising the step of:

disabling the step of performing said frame synchronization for a predetermined period of time after having switched-on a receiver (130) performing said method for frame synchronization.

24. An apparatus for generating a signal having a frame structure, each frame of said frame structure comprising at least one useful symbol (12), a guard interval (14) associated to said at least one useful symbol (12) and a reference symbol (14), said apparatus comprising:

an amplitude modulator for performing an amplitude modulation of a bit sequence, the envelope of the amplitude modulated bit sequence defining the reference pattern of said reference symbol (16); and

means for inserting the amplitude modulated bit sequence into said signal as said reference symbol (16).

25. The apparatus according to claim 24, wherein said signal is an orthogonal frequency division multiplexed signal.

26. The apparatus according to claim 24 or 25, wherein a mean amplitude of said reference symbol (16) substantially corresponds to a mean amplitude of the remaining signal.

27. An apparatus for generating a multi-carrier modulated

signal having a frame structure, each frame of said frame structure comprising at least one useful symbol (12), a guard interval (14) associated to said at least one useful symbol (12) and a reference symbol (16), said apparatus comprising:

means (102) for providing a bitstream (104);

means (106) for mapping bits of said bitstream (104) to carriers in order to provide a sequence of spectra (108);

means (110) for performing an inverse Fourier transform in order to provide multi-carrier modulated symbols (112);

means (114) for associating a guard interval to each multi-carrier modulated symbol;

means for generating said reference symbol (16) comprising an amplitude modulator for performing an amplitude modulation of a bit sequence, the envelope of the amplitude modulated bit sequence defining the reference pattern of said reference symbol (16);

means (116) for associating said reference symbol (16) to a predetermined number of multi-carrier modulated symbols (12) and associated guard intervals (14) in order to define said frame; and

means for inserting the amplitude modulated bit sequence into said signal as said reference symbol (16).

28. The apparatus according to claim 27, wherein said multi-carrier modulated signal is an orthogonal frequency division multiplex signal.

29. The apparatus according to claim 26 or 27, wherein said means for generating said reference symbol (16) performs the amplitude modulation such that a mean amplitude of said reference symbol (16) substantially corresponds to a mean

amplitude of the remaining multi-carrier modulated signal.

30. The apparatus according to one of claims 24 to 29, wherein said means for generating said reference symbol (16) generates a pseudo random bit sequence having good autocorrelation characteristics as said bit sequence.

31. The apparatus according to one of claims 24 to 30, comprising means for determining a number of useful symbols (12) in each frame depending on channel properties of a channel (122) through which the signal or the multi-carrier modulated signal is transmitted.

32. An apparatus for frame synchronization of a signal having a frame structure, each frame of said frame structure comprising at least one useful symbol (12), a guard interval (14) associated to said at least one useful symbol (12) and a reference symbol (16), said apparatus comprising:

receiving means (132) for receiving said signal;

a down-converter for down-converting said received signal;

an amplitude-demodulator (164) for performing an amplitude demodulation of said down-converted signal in order to generate an envelope;

a correlator (166) for correlating said envelope with a predetermined reference pattern in order to detect the signal reference pattern of said reference symbol (16) in said signal; and

means for performing said frame synchronization based on the detection of said signal reference pattern.

33. The apparatus according to claim 32, further comprising means (162) for performing a fast automatic gain control of said received down-converted signal preceding said

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amplitude-demodulator (164).

34. The apparatus according to claim 32 or 33, wherein said amplitude-demodulator (164) comprises means for calculating an amplitude of said signal using the $alpha_{max+}$ $beta_{min-}$ method.

35. The apparatus according to claim 32 or 33, further comprising means for sampling respective amplitudes of said received down-converted signal, wherein said amplitude-demodulator (164) comprises means for comparing said sampled amplitudes with a predetermined threshold in order to generate a bit sequence.

36. The apparatus according to claim 35, wherein said means for sampling comprises means for over-sampling said received down-converted signal.

37. The apparatus according to one of claims 32 to 36, further comprising means for applying a result of the frame synchronization for a frame in said signal to at least one subsequent frame in said signal.

38. An apparatus for frame synchronization of a multi-carrier modulated signal having a frame structure, each frame of said frame structure comprising at least one useful symbol (12), a guard interval (14) associated to said at least one useful symbol (12) and a reference symbol (16), said apparatus comprising:

a receiver (132) for receiving said multi-carrier modulated signal;

a down-converter for down-converting said received multi-carrier modulated signal;

an amplitude-demodulator (164) for performing an amplitude-demodulation of said down-converted multi-carrier modulated signal in order to generate an envelope;

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a correlator (166) for correlating said envelope with a predetermined reference pattern in order to detect the signal reference pattern of said reference symbol (16) in said multi-carrier modulated signal;

means for performing said frame synchronization based on the detection of said signal reference pattern;

means (136/138) for extracting said reference symbol (16) and said at least one guard interval (14) from said down-converted received multi-carrier modulated signal based on said frame synchronization in order to generate said at least one useful symbol;

means (140) for performing a Fourier transform in order to provide a sequence of spectra from said at least one useful symbol; and

means (142) for de-mapping said sequence of spectra in order to provide a bitstream.

39. The apparatus according to claim 38, further comprising means (162) for performing a fast automatic gain control of said received down-converted multi-carrier modulated signal preceding said amplitude-demodulator (164).

40. The apparatus according to claim 38 or 39, wherein said amplitude-demodulator (164) comprises means for calculating an amplitude of said multi-carrier modulated signal using the $alpha_{max+}$ $beta_{min-}$ method.

41. The apparatus according to claim 38 or 39, further comprising means for sampling respective amplitudes of said received down-converted multi-carrier modulated signal, wherein said amplitude-demodulator (164) comprises means for comparing said sampled amplitudes with a predetermined threshold in order to generate a bit sequence.

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42. The apparatus according to claim 41, wherein said means for sampling comprises means for over-sampling said received down-converted multi-carrier modulated signal.

43. The apparatus according to one of claims 38 to 42, further comprising means for applying a result of the frame synchronization for a frame in said multi-carrier modulated signal to at least one subsequent frame in said multi-carrier modulated signal.

44. The apparatus according to one of claims 32 to 43, further comprising means for detecting a location of said signal reference pattern based on an occurrence of a maximum of a correlation signal output of said correlator (166).

45. The apparatus according to claim 44, further comprising means for weighting a plurality of maxima of said correlation signal such that a maximum occurring first is weighted stronger than any subsequently occurring maximum; and

means for detecting said location of said signal reference pattern based on the greatest one of said weighted maxima.

46. The apparatus according to claim 45, further comprising means for disabling said means for performing said frame synchronization for a predetermined period of time after having switched-on a receiver (130) comprising said apparatus for frame synchronization.

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